Name: ……………………………………..
Class: ……………………
Date: ………………………
Practice 11

45 r's

Section A

Answer **all** the questions in this section in the spaces provided.

1 A parachutist jumps from an aeroplane 5000 m above ground and free falls for a while before opening the parachute. The total weight of the man and his parachute is 800 N. Fig. 1.1 shows how his speed varies with time over the first ten seconds after he jumped.

Time in s	**Speed in ms^{-1}**
0	0
1	10
2	20
3	30
4	40
5	50
6	30
7	20
8	15
9	12
10	12

Fig. 1.1

(a) Using the data given in the above table, plot the graph of speed against time in Fig. 1.2. [2]

Fig. 1.2

For Examiner's Use

(b) From Fig. 1.2, deduce the time at which the parachute opened.

…………………………………………………………………………………………………… [1]

(c) Calculate the parachutist's height above the ground when he opened his parachute.

height = ……………….. [2]

(d) Describe his motion during from 6 to 9 seconds.

……………………………………………………………………………………………………..

…………………………………………………………………………………………………… [1]

(e) (i) Between which two times is the parachute travelling at constant velocity?

…………………………………………………………………………………………………… [1]

(ii) What is the resultant force acting on the parachutist during this period in **(e)(i)**? Explain how you obtained your answer.

……………………………………………………………………………………………………..

……………………………………………………………………………………………………..

……………………………………………………………………………………………………..

…………………………………………………………………………………………………… [2]

For Examiner's Use

2 Fig. 2.1 (not drawn to scale) shows two forces of magnitude 15 N and 20 N, acting on a small object **O** at an angle of 60°. Determine the resultant force acting on the ball using an appropriate scale vector diagram. State the scale used. [4]

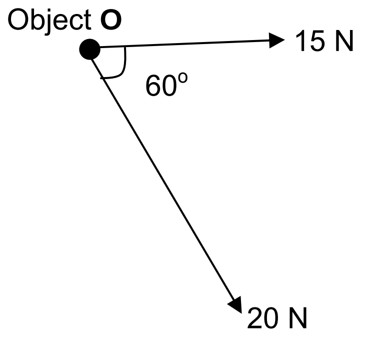


Fig. 2.1

For Examiner's Use

3 A cyclist with a mass of 80 kg is riding a bicycle. He stops at the top of a hill of vertical height 5.0 km before going down its slope. Take gravitational field strength, *g* as 10 N/kg.

(a) Calculate the weight of the cyclist.

weight = …………………….[2]

(b) What form of energy does the cyclist have at the top of the hill?

…………………………………………………………………………..……………...[1]

(c) Calculate the energy stated in **(b)** of the cyclist at the top of the hill?

energy = ………………...………...…..[2]

(d) State the kinetic energy of the cyclist when he reaches the foot of the hill. Ignore the effects of friction.

kinetic energy = ……………….………..[1]

(e) Calculate the speed when he reaches the foot of the hill.

speed = ………………...………...…..[2]

For Examiner's Use

4 Fig. 4.1 shows the inside of a factory chimney. The rods carry a large negative charge and the plate which is removable for cleaning is positively charged.

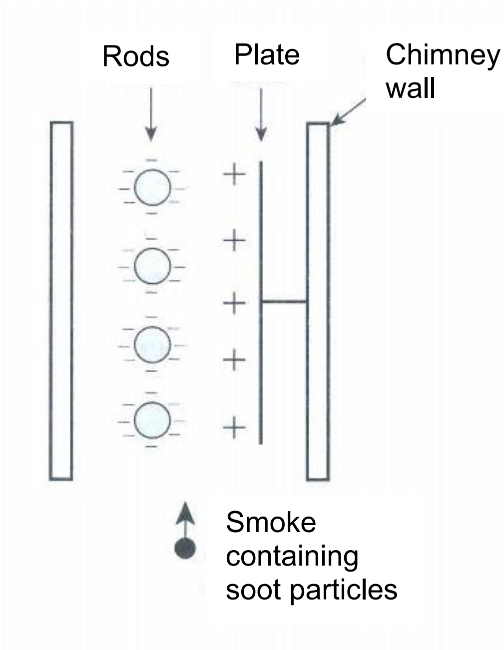


Fig. 4.1

(a) Explain what happens when the soot particles come into contact with the rods.

……………………………………………………………………………………………………..

……………………………………………………………………………………………………..

……………………………………………………………………………………………………..

…………………………………………………………………………………………………… [1]

(b) What would you observe when the soot particles come into contact with the rods? Explain your observation.

……………………………………………………………………………………………………..

……………………………………………………………………………………………………..

……………………………………………………………………………………………………..

…………………………………………………………………………………………………… [2]

For Examiner's Use

5 Fig. 5.1 shows the path of another ray of light passing through a block of glass.

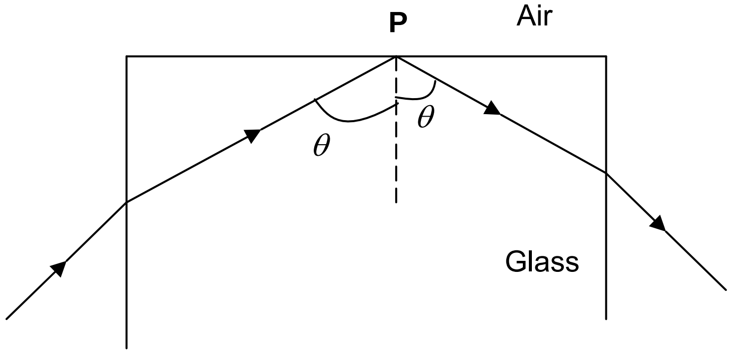


Fig. 5.1

(a) Name the effect shown in Fig. 5.1 at point **P**.

.... [1]

(b) Is the angle θ greater than, smaller than or same as the critical angle of the glass? Explain your answer. Also state the other condition for the effect in **(a)** to occur.

....

....

....

....

....

.... [2]

(c) If the refractive index of the block of glass is 1.45, calculate its critical angle.

critical angle = ...[2]

For Examiner's Use

6 Fig. 6.1 shows a circuit breaker with contacts closed.

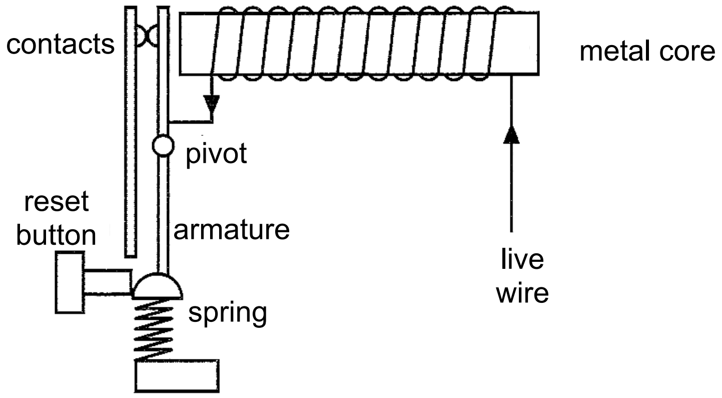


Fig. 6.1

Fig. 6.2 shows the same circuit breaker after a large current passes through the circuit.

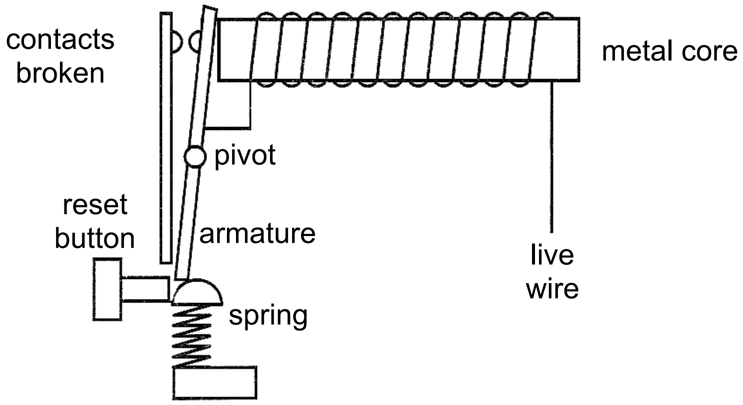


Fig. 6.2

(a) Describe how the circuit breaker switches off the current when it becomes too large.

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

………………………………………………………………………………………………… [3]

(b) Suggest a suitable metal to be used as the core in the solenoid and explain your choice.

…………………………………………………………………………………………………

…………………………………………………………………………………………………

………………………………………………………………………………………………… [2]

7 A simple d.c. circuit is as shown in Fig. 7.1.

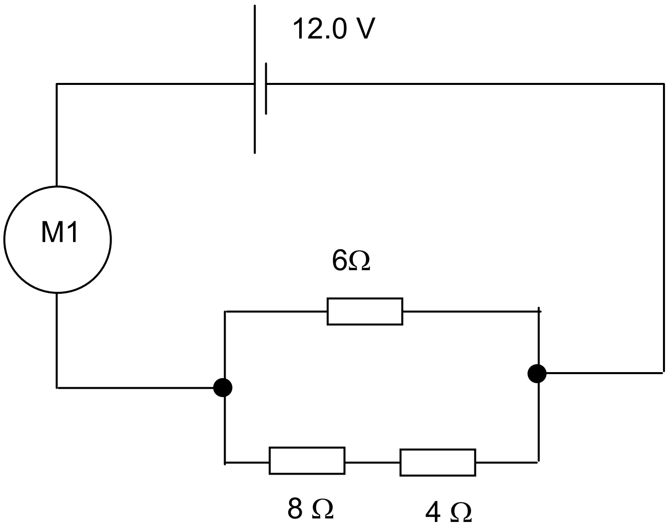


Fig. 7.1

(a) Is M1 an ammeter or voltmeter? Give your reason.

…………………………………………………………………………………………………

…………………………………………………………………………………………………

………………………………………………………………………………………………… [1]

(b) Calculate the effective resistance of whole circuit.

effective resistance = ……………………….[2]

(c) Calculate the current flowing in the 6Ω resistor.

current = …………………[2]

(d) Calculate the potential difference across the 4Ω resistor.

potential difference = ………………………[2]

For Examiner's Use

8 Fig. 8.1 shows how a kettle and oven are plugged into a 15 A socket. The rating of a kettle is '240 V, 2 kW' and an oven is '240 V, 2.5 kW'.

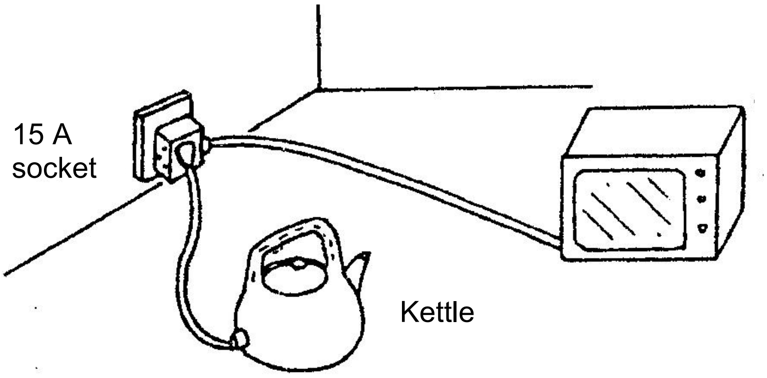


Fig. 8.1

Explain why this connection is dangerous. Show clearly all calculations you make in your explanation.

…………………………………………………………………………………………………...

…………………………………………………………………………………………………...

…………………………………………………………………………………………………...

…………………………………………………………………………………………………...

…………………………………………………………………………………………………...

…………………………………………………………………………………………………...

……………………………………………………………………………………………… ….[4]

Section B

Answer any **two** questions from this section.

9 **(a)** State the Principle of Moments. [1]

(b) A man is hanging out the laundry for drying. The pants, shirt and towel have masses 2.0 kg, 0.5 kg and 0.1 kg respectively.

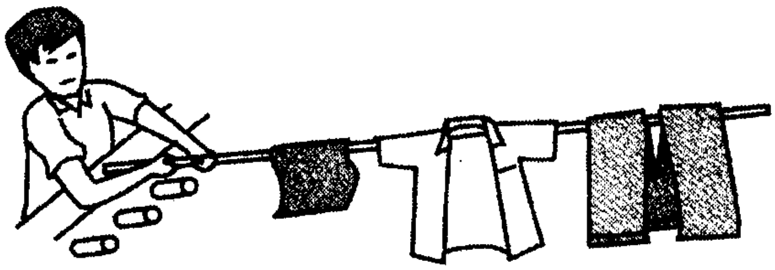


Fig. 9.1

(i) Is the man wise to arrange the clothing as shown? Explain. [2]

(ii) The centre of mass of the towel, shirt and pants are 0.6 m, 1.1 m and 1.6 m away from the end of rod nearest to the man. Why should the man hold the rod with both his hands as far apart as possible? [1]

(c) The man puts his left hand at a distance of 0.3 m from the end while his right hand acts as the pivot holding the end of the rod nearest to him as shown in Fig. 9.2.

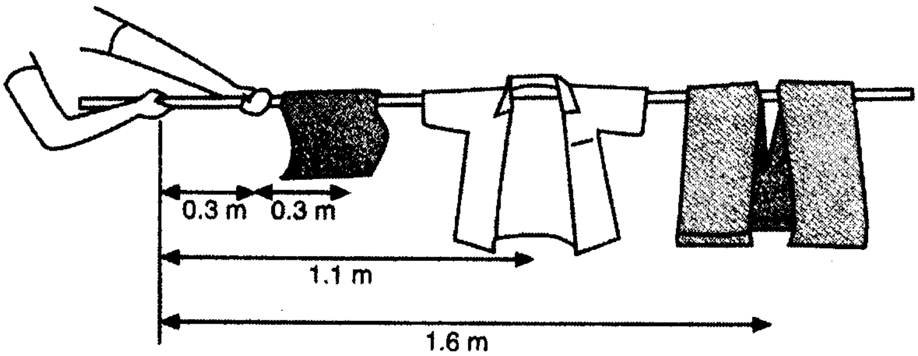


Fig. 9.2

(i) What is the direction of force exerted by the right hand and the left hand? [2]

(ii) Calculate the total moment due to the clothing about his right hand as the pivot. [2]

(iii) Calculate the force exerted by the left hand acting perpendicularly on the rod. [2]

10 (a) Fig. 10.1 shows the positions of three balls, **P**, **Q** and **R**, floating on the water surface in a pond. A uniform water wave is travelling from X to Y which causes Balls **P** and **Q** to complete one oscillation in every 3 seconds.

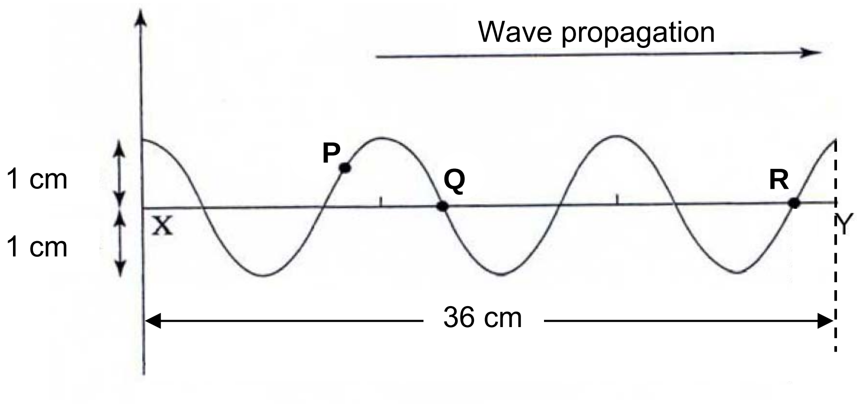


Fig. 10.1

(i) State the type of wave shown in Fig. 10.1. [1]

(ii) State the direction in which **R** is moving at that instant. [1]

(iii) Calculate the wavelength and frequency of the wave. [2]

(b) Ultrasound scanning is a technique used in the medical field to obtain information about the internal structure of the human body without the need for surgery.

An ultrasound of 4.0 MHz is beamed into a body from a transmitter placed on the body surface. The time taken for the sound reflected by different surfaces in the body to return to the transmitter is measured.

(i) Define the term ultrasound. [1]

(ii) The average speed of sound in the body is 1800 m/s. Calculate the wavelength of the ultrasound waves travelling in the body. [2]

(iii) When a short pulse of the ultrasound is beamed into the body, a reflected sound wave is received by the transmitter 5.0×10^{-5} seconds later. Calculate the distance from the surface of the body to the layer that produces the reflection. [2]

(iv) State one component of the electromagnetic spectrum which is used in cancer treatment. [1]

11 (a) (i) Using the kinetic theory of matter, describe what happens to the energy of water molecules as water is heated from 25 °C to 50 °C. [2]

(ii) State two differences between boiling and evaporation. [2]

(b) Fig. 11.1 shows an electric kettle.

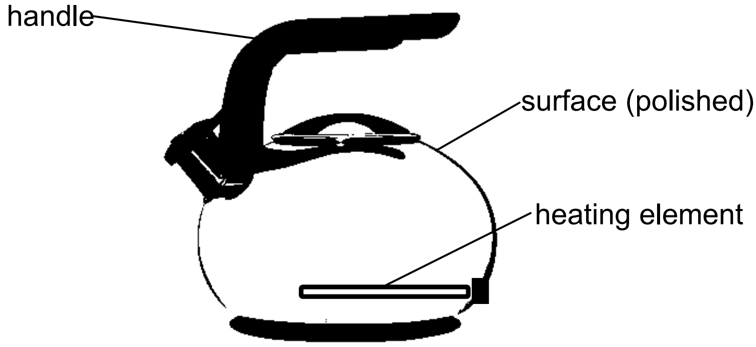


Fig. 11.1

(i) Explain why the surface of the kettle is usually polished. [2]

(ii) Explain why the heating element is usually placed at the bottom of the kettle. [2]

(iii) Explain why most kettles have plastic handles. [2]

For Examiner's Use

For Examiner's Use

For Examiner's Use

END OF PAPER 2

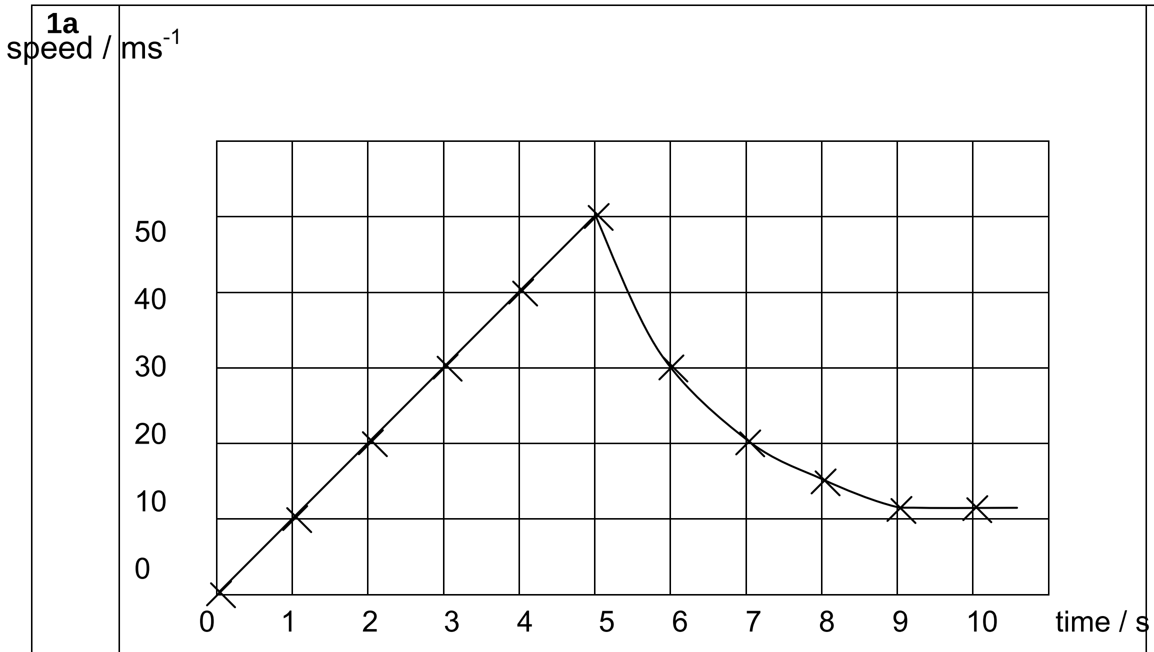
4E5N Sc(Phy) Prelim 2 (2011) suggested solutions

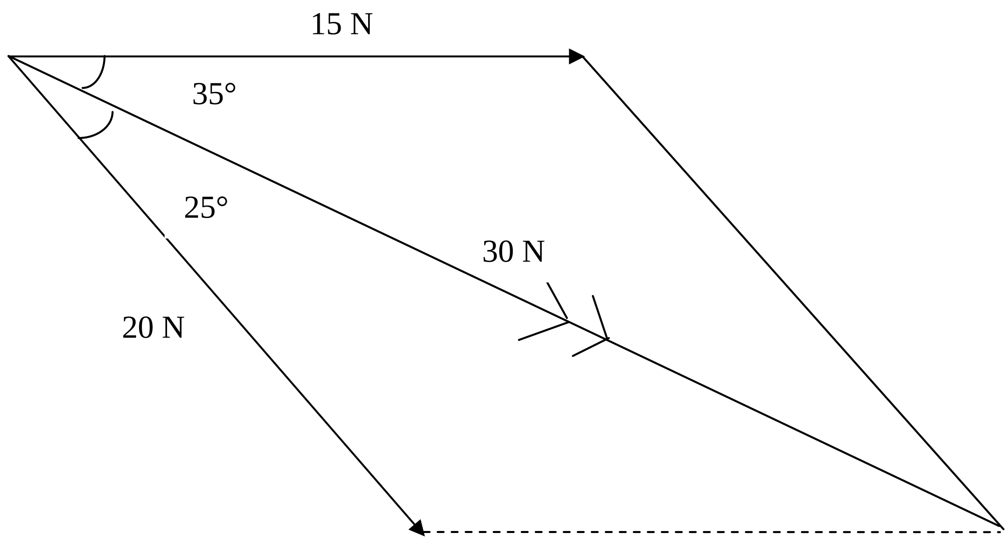
Paper 1

1	2	3	4	5	6	7	8	9	10
A	D	A	C	C	A	C	C	A	B
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
D	D	A	C	C	D	B	C	D	A

Paper 2

Section A

1a	 Correct shape of graph Correct time and speed	**B1** **B1**
b	5 seconds [1]	
c	Distance travelled between 0 to 5 seconds = ½ x 5 x 50 = 125 m Height from ground = 5000 – 125 = 4875 m **[Allow ECF]**	**A1** **A1**
d	His motion is **decreasing deceleration**.	**B1**
ei	9 to 10 seconds	**B1**
eii	**Resultant force is zero**. Since he is travelling at **<u>constant velocity</u>**, there is no acceleration. His weight is equal to the air resistance and hence giving a zero resultant force.	**B1** **B1**

2	 Scale of at least 1 cm to 2.5 N. Correct vector drawing and labelling of 2 forces Final answer of 30 N (Accept 27 - 33N) Correct orientation of 35° made between the resultant force and the 15 N force (Accept 32° to 38°) or 25° made between the resultant force and the 20 N force (Accept 23° to 27°) [Subtract 1 mark if arrows not present/wrong arrows drawn] [Subtract 1 mark if construction lines are not drawn with dotted lines] [Subtract 1 mark if orientation is wrong] [Subtract 1 mark if arrows not present]	**B1** **B1** **B1** **B1**
3a	80(10) = 800 N	**C1** **A1**
b	Gravitational potential energy	**B1**
c	GPE = 800(5000) = 4 000 000 J	**C1** **A1**
d	4 000 000 J	**A1**
e	½ (80)(v^2) = 4 000 000 v = 316 m/s	**C1** **A1**
4a	It becomes **<u>negatively charged</u>** because the electrons are transferred from the wire onto the smoke particles.	**B1**
b	The soot particles would be attracted to the plate because unlike charges attract.	**B1** **B1**
5a	Total internal reflection (reflections not accepted)	**B1**
b	Greater than. **Total internal reflection only occurs when the angle of incidence is**	**B1** **B1**

	greater than critical angle and when light travels from an optically denser to less dense medium.	
c	c = $\sin^{-1}$ (1/1.45) = 43.6°	**C1** **A1**
6a	When current is too large, the metal core becomes a stronger electromagnet which exerts a big force to attract the contact. Once the armature is **attracted to the core, the contact points are broken.** Hence the circuit breaker switches off.	**B1** **B1** **B1**
6b	Iron. Iron is a soft magnetic material which gains **magnetism quickly and loses magnetism immediately** when there is no current	**B1** **B1**
7a	Ammeter. Ammeters are connected in series	**B1**
b	Effective resistance = (12 x 6) / (12+6) = 4 Ω	**C1** **A1**
c	12 / 6 = 2 A	**C1** **A1**
d	Current through 4 ohm = 12 / 12 = 1 A **[Allow ECF]** Potential difference across 4 ohm = 1 x 4 = 4 V	**A1** **A1**
8	Current of oven = 2500 / 240 = 10.4 A Curent of kettle = 2000 / 240 = 8.33 A Total working current is **18.7A** which **exceeds the 15 A socket, resulting in overloading, overheating and possible fire.**	**A1** **A1** **B1** **B1**

Section B

<table>
<tr><td>9a</td><td>The principle of moments states that for a body to be in equilibrium, the sum of the clockwise moments equal the sum of the anticlockwise moments about the same pivot.</td><td>B1</td></tr>
<tr><td>bi</td><td>Not wise.
Heavier clothes far away increases the moment/he needs to exert more force</td><td>B1
B1</td></tr>
<tr><td>bii</td><td>The back hand is the pivot, the further the front hand, the less force he needs to lift the clothes.</td><td>B1</td></tr>
<tr><td>ci</td><td>Right hand – downward force
Left hand – upward force</td><td>B1
B1</td></tr>
<tr><td>cii</td><td>[(2.0x1.6)+(0.5x1.1)+(0.1x0.6)]x10
= [3.2+0.55+0.06]x10
= 38.1 Nm [Minus 1 mark for non conversion to N]</td><td>C1

A1</td></tr>
<tr><td>ciii</td><td>Force x 0.3 = 38.1
Force = 127 N [Allow ECF]</td><td>C1
A1</td></tr>
<tr><td>10ai</td><td>Transverse wave</td><td>B1</td></tr>
<tr><td>aii</td><td>Downwards</td><td>B1</td></tr>
<tr><td>aiii</td><td>Wavelength = 36 / 3 = 12 cm

f = 1 /T = 1 / 3 = 0.333 Hz</td><td>A1

A1</td></tr>
<tr><td>bi</td><td>Sound with frequency above audible frequency/ 20 000 Hz</td><td>B1</td></tr>
<tr><td>bii</td><td>Wavelength = 1800 / (4 x 10^6)
= 4.5 x 10^{-4} m</td><td>C1
A1</td></tr>
<tr><td>biii</td><td>Distance = 1800 x 0.5(5.0 x 10^{-5})
= 0.045 m</td><td>C1
A1</td></tr>
<tr><td>biv</td><td>Gamma rays</td><td>B1</td></tr>
<tr><td>11ai</td><td>The molecules gain kinetic energy due to the increased temperature and move around the liquid at faster speeds.
The molecules' potential energies remain the same.</td><td>B1

B1</td></tr>
<tr><td>aii</td><td>
<table>
<tr><th>Boiling</th><th>Evaporation</th></tr>
<tr><td>Fast process</td><td>Slow process</td></tr>
<tr><td>Has bubbles</td><td>Has no bubbles</td></tr>
<tr><td>Occurs throughout the liquid</td><td>Occurs only at the surface of the liquid</td></tr>
<tr><td>Heat has to be supplied externally</td><td>Take in energy from the surroundings</td></tr>
</table>
Any 2 differences, 1 mark for each difference</td><td>B1
B1</td></tr>
<tr><td>bi</td><td>Polished surfaces are poor emitters of radiation.
This can help to reduce heat loss from the hot water in the kettle.</td><td>B1
B1</td></tr>
<tr><td>bii</td><td>When the heating element is switched on, the water surrounding the heating element/at the bottom will get heated up, becoming less dense and rises.
Cooler, denser water in the upper regions will sink to replace the heated water, creating convection currents in the water to enable all the water in the kettle to be heated up.</td><td>B1

B1</td></tr>
<tr><td>biii</td><td>Plastics are poor conductors of heat.
This can help to insulate a person from the hot kettle and preventing burns.</td><td>B1
B1</td></tr>
</table>